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# ARTIFICIAL FERTILIZERS

NOT A NECESSITY.

A TREATISE ON

THE RECUPERATING ENERGIES OF NATURE  
IN AGRICULTURAL SCIENCE.

BY WM. M. GOGGIN,

Of Shelbyville, Tenn.

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## ARTIFICIAL FERTILIZERS NOT A NECESSITY.

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HOW can a soil that was once rich in the elements of organic life, and which through cultivation or otherwise has lost its productive power, and ceased to yield, regain its life-sustaining properties? Does nature possess within herself any recuperating energies, by which, through the operation of her own laws, fertility can be restored to an exhausted soil, and the barren land again be made a fruitful field? In these questions are embraced not only the temporal interests and well-being of the human race, but the whole animal kingdom, as well as man, that have derived their organic structure from the dust of the earth, for all alike must have their natural life sustained by the productions of the earth as their natural mother. While these questions are of universal interest, they make their appeal in stronger terms to the agriculturist than to any other class of mankind, or than to any other portion of the animated world; because the agriculturist has the manipulation of the soil by which the earth is made, through the operation of nature's law, to yield the elements of fertility in productive abundance for the sustenance of all her inhabitants. And it is the province of the agriculturist, by good cultivation and judicious management of the soil, to do this on the one hand, or, by bad cultivation and injudicious management on the other, of exhausting the soil of its fertility through the operation of nature's laws, and thus depriving the

earth of her full capacity to feed and sustain the natural life of all her children.

It will hardly be denied that it is through the operation of natural laws that the earth is made fertile for good in the production of life-sustaining food. Neither will it be denied that it is through the operation of nature's laws that the soil becomes exhausted, made barren, and for evil deprived of her full capacity to yield her life-sustaining food. If, then, it be true that it is through the operation of nature's laws for good that the earth is made fertile on the one hand, and that it is through the operation of nature's laws for evil, on the other, that the earth is deprived of her fertility, and made barren, the importance of the agriculturist in the economy of nature is readily perceived. There was a period in the history of nature when the earth spontaneously produced all the sustenance necessary for the maintenance of the then existing animal kingdom; but mutation is a law of nature, and for the present leaving out of consideration all moral causes, there came a period when there was a change in the natural world that caused the soil to be less fertile, and through the operation of nature's laws brought partial barrenness upon the land, and thus deprived the earth of her capacity to yield spontaneously a full supply of life-sustaining food; and it became necessary for man, by the cultivation of the soil, to come to the aid of nature in the operation of her laws that tend to productive fertility, and thereby to counteract the evil in nature's laws in their tendency to barrenness and desolation.

Then, to prevent the evil tendency of nature through the operation of her laws, and to aid her in her tendency to good through the operation of her laws, is the task that is imposed upon the cultivator of the soil. If

this be true, then, let me speak a word of encouragement to the hard-working toiler upon the farm in reference to the dignity of his occupation. His position as a cultivator of the soil places him in his vocation upon an eminence in the natural world above the vocation of all other men, for to him is given the high and responsible position of directing the laws of nature into the channels of productive fertility that feed the world, thus making all others dependent upon him in his vocation. But it must be remembered that there is also another view of the position to which his vocation calls him. He must remember that his responsibilities are adequate to the dignity of his vocation; he must remember that it is upon his knowledge, his good judgment, and the fidelity with which he executes his trust, that his reward depends, either of honor or of pecuniary benefit. This responsibility and this hope of reward makes it necessary for the cultivator of the soil to understand something of the operation of nature's laws in her production of that which sustains organic life in the natural world; and just in proportion to his understanding of these laws and their operation, and the fidelity and skill with which he complies with them in his labors upon the soil, will he be able to direct them in the channels of productive fertility, and thus be able to maintain the perpetual productiveness of the earth; while, on the other hand, just as he is ignorant of nature's laws of production, and negligent or unskillful in the application of his labor, will he promote the operation of nature's laws in bringing exhaustion, barrenness, and desolation upon the land. Then, it is easy to perceive the advantages to the country and to the world, and the absolute necessity to the tiller of the soil, of thorough education in all agricultural knowl-

edge, and a thorough education in the operation of nature's laws of production, that he may be able to direct them in the channels of continued fertility, and prevent them from running into the channels of exhaustion that would bring the soil into a state of barrenness and desolation. This position, that it is necessary for the cultivator of the soil to direct the laws of nature, and keep them running in the channels of productive fertility, necessarily implies that if they are not so directed by the judgment and skill of the cultivator, they will run in the channels of exhaustion that tend to lessen the productive capacity of the soil in the essential properties of life-sustaining food. This position assumes that if the laws of nature are not by cultivation directed in the channels of productive fertility, the earth will in process of time become a barren desolation through the operation of nature's laws. That is, if the chemical properties of the soil are not by cultivation directed in the channels of productive fertility, the chemical combination of elementary properties will become so changed in the soil into other and destructive combinations that the earth will cease to bring forth to maturity and perfection that class of organism in the vegetable kingdom that furnishes the life-sustaining food of man; and thus the earth will become, through the operation of nature's laws, a barren desolation under the changed condition of the earth by reason of the curse that was put upon it for man's transgression of the moral laws of God; hence the necessity of cultivation to direct the laws of nature in the channels of productive fertility. Though the curse was denounced upon the earth to bring labor, toil, and suffering upon man, it constitutes within itself the highest possible blessing to the physical well-being of man, and of all

the animal kingdom that are dependent upon the productions of the earth for subsistence, while at the same time it brings nature, in the operation of her laws, upon the stand as an everlasting witness to the truth of divine revelation.

Now, what I mean by exhaustion or infertility of the soil is not a withdrawal of the primary elements of original fertility, for in this sense exhaustion is impossible—nature can never lose any of the primary elements of material being so long as she maintains her material existence—but as mutation is a law of nature, it is impossible for elementary properties to continue in the one combination, or forever to bring forth the same forms and properties of product, through the soil in which the changed combination has been made. Hence, when I say the soil has become exhausted and the earth made sterile, I mean that by mutation as a law of nature a change in the combination of elementary properties has taken place in the soil that has rendered it incapable of bringing forth in proper combination of elementary properties the products of earth that are necessary to the life of man. So, then, it is by the law of mutation that the soil is deprived of its fertility in the products necessary to sustain the life of man. So it is also by the law of mutation that the soil is made fertile in the products necessary to sustain the life of man. Then, if this be a true and correct position, it necessarily follows that nature does possess through the operation of her own laws the recuperating energies adequate to restore fertility to an exhausted soil. If it be true that nature does possess the power within herself, through the operation of her own laws, the recuperating energies necessary to restore fertility to an exhausted soil, and perpetuate its productiveness, the question

naturally presents itself, Is it absolutely necessary for the cultivator of the soil to resort to the use of artificial fertilizers, or the natural fertilizers from the barnyard, either to restore fertility to an exhausted soil or to perpetuate its fertility when restored? Agricultural science, as I understand it, teaches that it is an absolute necessity, because it teaches that the soil is possessed of a fixed and definite amount of the elements of fertility down to a certain depth, and that the land is rich or poor in fertility in proportion to the amount of these elements which it contains. Upon this principle as an axiom in agricultural science is based the theory that, as every crop taken off the soil carries with it more or less of these elements of fertility, it is an absolute necessity that their equivalents be by some means returned to the soil from whence they were taken. If they are not returned, and continued cropping is carried on, the land will ultimately be drained of all its elements of fertility, and become, by this process of cultivation and starvation, a barren desolation. Now, I ask, Does this harmonize with the facts that nature teaches when she declares that she does possess the recuperating energies, through the operation of her own laws, that will restore fertility to an exhausted soil, and perpetuate its productiveness when restored? Does it harmonize with the teachings of nature when she declares that mutation is a law of her existence? Mutation being a law of nature, there cannot be and remain fixed in the soil a definite amount of the fertilizing properties of life-sustaining food. The elements of perfect fertility can only exist in one form of organic food-supply in one combination at one time, and on account of the mutation of matter can only remain in that one combination but for a short period. Then, nature must

have some other mode of carrying on her operations through which she maintains the perpetual fertility of the soil that is as yet unknown to man, and by which she is enabled at the same time to impoverish one portion of the earth's surface and fertilize another. But again, mutation being a universal law of nature, the primary elements of fertility cannot exist originally in that combination of fertility that will furnish food to sustain the life of man; but they do perpetually exist in other forms and other combinations, until by internal forces they are brought to the surface of the earth, and placed within the compass and under the influence of external agencies, to be by external agents changed into that combination of elementary fertility that produces life-sustaining food for man. This internal force that perpetuates the ceaseless rounds of the earth's fertility is the expansive force of internal heat that forever dwells in the center of the earth, without which the surface of the earth would soon become a barren waste without the vestige of vegetation, and a desolation without the existence of animal life. The external agents are air, light, heat, and cold. The light and heat generated by the sun in the earth's atmosphere, and radiated upon the surface of the earth, the sun being the vital force or first visible fountain of natural life, and water acting as a solvent, the air being vitalized by the sun, meets the primary elements of fertility in the surface-soil, carrying life into the surface-soil to the utmost depths which it can reach, building up for itself vitalized organic structure possessing form and properties as diverse as are the combinations of elementary properties that find their lodgment in the surface-soil; and cold as an agent to regulate the temperature necessary to produce changes in elementary condition, and to

hold in one combination the primary elements thus changed until the beneficial purposes of that combination have been accomplished. These I conceive to be the leading external agents and the order of their functions in the economy of nature. To regulate and control these agents, and direct them in the channels of productive fertility in the soil, that will cause the earth to bring forth in the greatest amount and in the greatest variety of forms the products necessary to sustain the life of man and beast, is the business of the cultivator of the soil, and is what was meant when it was said that it was the business of the cultivator of the soil to direct the laws of nature into channels of productive fertility in the elements of life-sustaining food. The farmer can stir his land deep or shallow, he can pulverize his soil fine or coarse, and open it minutely or partially deep or shallow to the penetration of the air, to have its primary elements vitalized by radiated light and heat from the sun according to the labor bestowed in preparing the seed-bed and cultivating the crop; and if the rain-fall and the dews are too small in quantity to be a sufficient solvent, he may supply that deficiency by irrigating his land; and in this way the cultivator of the soil can come to the aid of nature in the operation of her laws, directing them in the channels of fertility in the products necessary for the sustenance of man and beast.

Upon this theory of the operation of nature's laws of productive energy it is not absolutely necessary for the farmer to resort to artificial fertilizers, or to fertilizers placed in productive combination by the art of man, for it supposes that in the mineral properties of the soil exist all the elements of organic life, but not in that combination of productive fertility of vegetable organ-



ism necessary to sustain the life of the animal kingdom. This combination of elementary properties is effected in the surface-soil, through the operation of nature's laws, by the external agents above referred to. These agents may be directed into the channels of productive fertility, and the products of the land be changed or modified according to the skill or judgment of the cultivator of the soil. The reason why the forms of all organic life were first developed through the mineral elements of the soil is because all the soil that composes this great globe of earth upon which we live, and of which we, in our physical organism, are a constituent part, is composed of mineral elements, variously combined, that was once in a condensed state, and that once existed in a state of solid mineral, condensed into one solid mass, in the center of the great globe of waters that compose the atmosphere, the water, and the dry land of the earth as it now exists. This mass of condensed mineral matter that was, through the operation of nature's laws, once lodged in the center of the great globe of waters, but which, through the operation of nature's laws, was there again fused into a liquid state, and that portion of mineral matter that does not at any one time enter into and compose the crusts of the earth, is still in a state of fusion in the center of the earth, or below its outer crusts, where the mineral elements must forever continue in a state of fusion; if it does not, the surface of the earth will become a barren waste, destitute of vegetation, and a desolation without inhabitant, because it is this internal heat, this fused state of mineral matter below the crusts of the earth, that is the fountain that supplies the surface-soil with the mineral elements of plant-food, first in the formation of crusts of the earth out of the mineral matter

condensed at its center, and now by the gases of the fused mineral escaping into the atmosphere through the crusts of the earth. To arrest these mineral elements in their circulation, prevent their escape into the atmosphere, and hold them in the surface-soil until they are put into the proper combination of productive fertility by the external agents, and appropriated by the crops as plant-food, is the business of the cultivator of the soil, if he would escape the necessity of using artificial fertilizers to restore fertility to his exhausted land, and keep it in a fertile condition when restored. How best to do this is a question yet to be solved, and doubtless will depend very much upon the practical observation of the cultivator of the soil. This theory is based upon the mutation of matter as a law of nature, and proposes to utilize the law of mutation to replenish the soil that is being continually exhausted by mutation of the primary elements of the material world in their ceaseless rounds of varied form and varied combination.

This theory of the recuperating energies of nature, if I understand the record, was first proclaimed by Moses in his historical account of the creation of the heaven and the earth, and is, therefore, as old as the order of nature, through the operation of whose laws the heaven and the earth were brought to perfection at the end of the sixth age of the world's existence.

Having previously given my interpretation of that record in a manuscript treatise, entitled "Progression, or the Genesis of the Natural and Spiritual World," I shall, therefore, quote from that treatise so much of my interpretation of the historical record of creation as I think may relate to, or throw light upon, the recuperating energies of nature in their application to agricult-

ural science; though that interpretation of the historical record of creation was not written with any view to agricultural growth or the development of agricultural science, but was written for the purpose of unfolding and bringing into conspicuous light the truth of divine revelation which is based upon that record. In my interpretation of the Mosaic record of creation, I was forced to adopt what I termed an astronomical theory, or a theory based upon the motion of the heavenly bodies; for upon no other hypothesis could I obtain a rational understanding of that record, and harmonize other revealed truths with its teachings. Moses commences his historical record of creation by saying: "In the beginning God created the heaven and the earth. And the earth was without form and void; and darkness was upon the face of the deep." That is, as I understand it, in the beginning of the first age of the earth's existence the earth was created a globe of waters, not surrounded by any atmosphere, but containing within itself the atmosphere, and not containing any form of organic structure, but containing in elementary properties all organic structure and life. Upon this theory of the motion of the heavenly bodies, the darkness that enveloped the earth at its creation defines the locality of the earth at that period as being so remote from the sun, and so far beyond the limits of the solar system to which it now belongs, that the light of the sun did not reach it until near the end of the first age, and consequently darkness covered the face of the deep chaotic mass. In support of this view, the record says: "The Spirit of God moved upon the face of the waters. And God said, Let there be light; and there was light." Upon this theory the sun, as the center of the solar system, with all its retinue of worlds, was then, as it is now,

moving through space upon a great circle that led in the direction of the locality of the earth; and it is assumed, upon this theory, that when the Spirit of God moved upon the face of the dark globe of waters, the newly-created earth was energized and caused to revolve upon its axis, and was also put in motion, or caused in revolutions to move upon a great circle or orbit of its own. This circle, or orbit, upon which it is still moving, led in the direction of the orbit upon which the sun and the solar system are moving. This great orbit upon which the earth is here supposed to be moving is so vast in extent that it will take all the seven periods of duration mentioned in the historical account of creation for it to make one revolution. As the history of creation mentions specifically the work that was done in each successive age, we may suppose the orbit of the earth to be divided into seven equal parts, and when the earth has passed over one-seventh of its orbit, that age in the duration of nature's existence ends; and the record describes the work that was done in that age, and so on through all the ages mentioned in the record. And when the seven periods mentioned in the record that it takes for the earth to make her revolution upon this great orbit are passed, the works of God in nature will end, the natural world will cease to exist, and a new heaven and a new earth will be brought into being through the operation of higher and more exalted laws; for we are told in Revelation that there shall be a new heaven and a new earth.

When in the first age the earth and the sun had so far approximated each other that the light of the sun had reached the earth, the record says, "And God saw the light, that it was good." God saw that his will was obeyed in nature through the motions given by his

Spirit to the worlds which he had created, and that by their motions upon their respective orbits the light of the sun had reached the earth, and lighted up the newly-created world that had hitherto been concealed in darkness. And God saw that the light was a suitable agent through which to develop the forces of nature, and bring her laws into active exercise that would make changes in the material world, through the force of which nature might be vitalized, her organic structures be built up, and creation be brought to perfection. "And God saw that it was good." When the light of the sun reached the earth, light was, and darkness was, whereas before all was darkness. The light was on the side of the earth next to the sun, while in the shadow of the earth it was dark on the other side, and thus the light was divided from the darkness. However, or by whatever means or agencies, if any, that motive power was given to the globe of waters, the earth was made to revolve upon its axis.

The light of the sun continually shining, the side of the earth next to the sun would be continually lighted up by its rays. The revolution of the earth upon its axis carried the side of the earth next to the sun into the shadow of the earth, and it was dark, while the side of the earth that was in the shadow was brought up to the face of the sun, and it was light; and thus the light and the darkness were made to succeed each other alternately. "And God called the light day, and the darkness he called night; and the evening and the morning were the first day." So we learn from the record that in the beginning of the first age the earth was in darkness, that darkness covered the face of the deep. The age began in darkness and ended in light, and this is the reason why the evening, or period of darkness,

is placed first in the historical record. The earth has now passed over one-seventh of its orbit, and the first age assigned for its existence is closed, together with the record describing its historical events.

A new era now dawns upon the world, and new events are to occur, and a new record is to be given of their historical occurrence, for the light of the sun has now reached the earth, and begun to develop the forces of nature as we have seen in the division of the light from the darkness, and the regularity with which the one succeeds the other. The sun and the earth continuing to move upon their respective orbits, their continued approximation gives a continually increased power to the sun over the earth, by which new forces are developed that produce the events recorded in all the different ages up to the creation of man.

The second age, like all that remains of the six, the history of which has been recorded, opens with an imperative command from God. The language of the record is, "And God said, Let there be a firmament in the midst of the waters, and let it divide the waters from the waters." The command being given, the record says: "And God made the firmament, and divided the waters which were under the firmament from the waters which were above the firmament; and it was so." That is, was so done as he commanded that it should be done. Here we have the sacred historian recording the fact that God gave the command that certain things should be done, and then saying that God himself did the work after he had given the command that it should be done, and, after the work was done, then reporting the fact that God acknowledged that the work was so done as he commanded that it should be done. If God himself in unity alone did the work of creation by

the utterance of the command, and it was so done, why did he give the command as if given to a second person, "Let there be a firmament; let the waters be divided; let the earth bring forth?" etc. Did God himself alone in unity give the command to himself alone in unity, and then do the work himself alone in unity, and, after the work was done, acknowledge to himself alone in unity that the work was so done as he commanded that it should be done? Nay, verily; such a proceeding in the history of creation would be inconsistent with the attributes of God. It cannot, therefore, be considered that God was acting alone in the unity of one person in the creation of the heaven and the earth; and if God was not acting alone in the work of creation, the question arises in our mind, To whom did God give the command when he said, Let there be a firmament, and let the waters that are under the firmament be divided from the waters that are above the firmament? And to whom did God acknowledge that the work was so done as he had commanded that it should be done? The only answer that we are authorized to give to this question is that it was the ever-living Son of God, who is the Creator that obeyed the commands of God, and who, in the work of creation, is called the Word, and who, as God, was then dwelling in the natural attributes, and by whom, in their exercise, God created all things in contradistinction to the moral attributes of God, and by whom God, in the fullness of all his attributes, both natural and moral, created all things, both in the natural and in the spiritual world. The sun continues to be the great agent that God employs to develop the forces of nature and put his laws into active exercise, through which his purposes are accomplished and his commands are

obeyed in creation. Then, to see how the firmament was made, and the waters were divided from the waters, we must again refer to the orbits of the earth and the sun. The continued approximation of the earth and the sun on their respective orbits gave increasing light and heat from the sun upon the globe of waters which, as a force of nature, was generated upon its surface. From heat, as a force of nature thus generated upon the face of the waters, there was expansion, a vaporization of the waters, and their ascension in vapor and gaseous form above the globe of waters, and thus not only making the firmament, but also dividing the waters above from the waters that were under the firmament. "And God called the firmament heaven." It is expressly declared that in the beginning—that is, in the commencement of the first age—God created the heaven and the earth, and it is here declared that in the second age God made the firmament, and called it heaven. Here arises the necessity for a distinction between the words *create* and *make*. In the beginning of the first age God created—that is, originated—the material elements of the heaven (the firmament) to make the firmament in the second age, and call it heaven; so that both declarations are true, both as to fact and date. In the beginning of the first age God did, by the exercise of his omnipotent power, or at least without any revealed or known laws, create the material world, in which existed, when created, all the matter that enters into and constitutes the firmament, which he called heaven. And not only was the heaven thus created in the beginning of the first age, but also all the material elements that enter into and compose the mineral, the vegetable, and the animal kingdoms were created in the beginning of the first age; but as bodies of form



and living being they were dormant, and their forms were hidden in darkness and in chaos until the forces of nature developed into active exercise the laws of production, by which they were evolved out of chaotic darkness, and placed in visible form in the creation of the natural world. These forces, of nature were the natural attributes of God, which were made active through natural laws ordained of God for the creation of the natural world, in contradistinction to his moral attributes and moral laws, through which he creates the spiritual world. These forces, or natural attributes, dwell eternally in God, and were called into active exercise, through the agencies which he ordained for their development, just as fast as the progress of creation prepared the world for new events and new forms of being. Thus we find that in the second age this progressive order had so far advanced that the increased light and heat from the sun upon the globe of waters had developed into active exercise the force of expansion and laws of vaporization, and the consequent ascension of material elements in gaseous form above the waters, thus making the firmament, and dividing the waters above from the waters that were under the firmament.

At the beginning of the first age of the world's existence the earth was so far out in the great void of space, and so remote from the sun, that the light and heat from the sun did not reach it, and it was, therefore, both in darkness and without a surrounding atmosphere. But in the second age, as we have seen, the atmosphere was drawn out of chaos by the force of expansion, and was developed into active exercise by the light and heat of the sun, and was made to surround the earth; and thus did the forces of nature, the natu-

ral attributes of God, obey the commands of God when he said, "Let there be a firmament in the midst of the waters, and let it divide the waters that were above from the waters that were under the firmament." "And the evening and the morning were the second day."

But expansion was not the only force that was in process of development during this age; for the same great agent that developed expansion also caused condensation by cohesion, and the formation of crystallized solids in the waters not vaporized; and when solids were formed, gravitation became an active force in the globe of waters, preparatory for the production of events recorded in the third age.

The earth had now gone through two-sevenths of its orbit, and still approximating the sun, the power of light and heat from the sun was augmented upon its surface; and entering upon the third age of its existence, the commands of God are again uttered, "And God said, Let the waters that are under the firmament be gathered together unto one place;" that is, let the waters that were not yet vaporized, and made to constitute the firmament, but that still remained under the firmament, "be gathered together unto one place, and let the dry land appear, and it was so;" and it was so done as he commanded that it should be done. And so the commands of God continued to be given in every succeeding age after the creation of the heaven and the earth, in the beginning of the first age, until the heaven and the earth were made perfect, and all the orders of creation were brought into form and structure, in a state of natural perfection, at the end of the sixth age. In view of these facts, as set forth in the divine record, it becomes a matter of interest to the searcher after light and truth to know who was the

person to whom these commands were given. We can only learn from the record of creation that the commands were given, and that the work was done in satisfactory obedience to the commands. We cannot learn from that record who it was that was then dwelling in the Godhead, by whom God made all things, because the period had not yet arrived in the history of the world for the manifestation of this indwelling person of the Godhead; for this belongs to the moral economy of God, and not to the natural economy of God, the history of which he is now recording. But the period has now arrived in the history of the world when he may be known, for the moral economy of God is now in process of development. And God has revealed him, and to find him in the moral economy of God, to whom God gave the commands of creation, we have only to turn our attention to the first chapter of the inspired evangelist John, and we read as follows: "In the beginning was the Word, and the Word was with God, and the Word was God. The same was in the beginning with God. All things were made by him, and without him was not any thing made that was made. In him was life, and the life was the light of men. And the light shineth in darkness, and the darkness comprehended it not." And in verses 9-14 we read: "That was the true Light, which lighteth every man that cometh into the world." "And the world was made by him." "He came unto his own, and his own received him not;" that is, the world was his own, for he made it. "He came unto his own, and his own received him not" as its maker and the bestower of natural life. "But as many as received him"—that is, as many as received him as the maker and bestower of natural life—"to them gave he power to become the sons of

God, even to them that believe on his name," to them gave he power to be born of the Spirit of God, and made to possess spiritual life—born not of natural life, nor of the will of the flesh, nor of the will of man, but of God. "And the Word was made flesh, and dwelt among us." The maker of the world was made flesh, and dwelt among us. Here, in the record of the moral economy of God, we have it fully set forth by an inspired writer who it was that was with God in the beginning of the creation of the natural world, and who it was to whom the commands to make the natural world were given, and for whom and by whom God made all things that were made. And we have also here revealed to us the name by which he is known in the Godhead as the creator and maker of all things. The Word was his creative name. "In the beginning was the Word, and the Word was with God, and the Word was God. All things were made by him, and without him was not any thing made that was made." "The Word was made flesh and dwelt among us, and ye beheld his glory." When at his baptism he was declared by the Spirit of God, in a voice from heaven, to be the only-begotten Son of God, and as the Son of God manifest in the flesh, his name in the Trinity, as mediator between God and man, is Jesus Christ, the Saviour, the anointed, the chosen, and ordained of God from the foundation of the world to be the mediator between God and man.

But to return to the natural economy of God, and pursue the history of the creation of the natural world as I find it in the record of Moses. I learn that when that great force-developing agent, the sun, that God had ordained to develop the forces of nature, had brought into active exercise the laws necessary to bring order

out of chaos, the result followed in obedience to the will of God, and his commands were obeyed as if he had spoken, and it was done; he commanded, and it stood forth.

" We have seen in the second age of the world's existence the development of the force of expansion caused by the light and heat of the sun generated upon the surface of the waters in the first and second ages of the world's being. We have also seen in the second age that by the force of expansion caused by the light and heat of the sun the waters were divided from the waters, and the atmosphere was made to surround the earth. When the atmosphere had been made to surround the earth, electricity, as a force in nature, was generated by the same great agent, and chemical combination of mineral properties followed, and cohesion was developed, and by cohesion solids were formed in small crystals in the surface of the waters. When solids were formed, gravitation became an active force in the globe of waters, attracting to the center of the globe of waters the solid particles that cohesion had formed in its surface-waters. By the force of gravitation these solid particles were settled in the center of the globe of waters, and by cohesion were there formed into a solid mass of mineral matter, thus making a solid foundation, upon which the surrounding waters rested. The augmentation of light and heat upon the surface of the globe continually increasing the volume of electricity upon its surface through the gases of the atmosphere, that subtle fluid, by an effort to restore an equilibrium to its condition, that was continually being destroyed by its continually increasing volume, was conducted in electric currents from every part of the earth's surface where it had been generated to its center, and the

currents of electricity, meeting in the center of that compact mass of minerals, there formed a heat, was there accumulated the continually increasing force of which that compact mass could not resist; and by the expansive force of heat there accumulated the solid barriers of the earth's foundations were broken up, many of the smaller fragments of rock were melted by the intense heat, while many of the larger ones were ground into gravel, sand, and fine dust by the long-continued boiling and surging of the liquid mass of fire, while other rocks of still larger dimensions were elevated from the center of the earth as far as the expansive force of as yet accumulated heat could carry them, and there by the same force held in position, thus forming a compact outer crust inclosing the internal heat, and forming a solid bed of rock upon which the gravel, sand, and dust of the ground-up rocks were continually being deposited in large beds. The agitation of the surrounding waters caused by the boiling and surging of the waves of internal heat drifted these beds of dust, sand, gravel, and ground-up rocks into many high elevations in the bosom of the great globe of waters. The volume of electricity continuing to increase upon the surface of the waters, the internal heat was continually being increased, and the expansive force of internal heat was thus continually augmented until these drifts of dust, sand, gravel, and broken and ground-up rocks were elevated above the surrounding waters by its expansive force, the waters as a consequence resting between these elevations. And the commands of God were obeyed, the dry land appeared, and the waters were gathered together unto one place. "And God called the dry land earth, and the gathering together of the waters called he seas." And thus God records

the formation of the mineral kingdom and the formation of the earth out of the mineral kingdom, and also the age of the world in which these events occurred. These commands of God being obeyed, God proceeds to give another command in the same age: "And God said, Let the earth bring forth grass, and herb yielding seed, and fruit-tree yielding fruit after his kind, whose seed is in itself," upon the earth—that is, whose seed of the vegetable kingdom was created in elementary properties in the earth in the beginning of the first age of the world, when God created the heaven and the earth to be made or brought forth in visible structure and organic life in all their different varieties and kinds in this the third age of the world. The earth being prepared as above described, it was perhaps richer in the mineral elements of plant-food than it has ever since been, or at least the mineral elements in proper combination were more accessible for the nourishment of the vegetable kingdom then than they have ever been since the curse was denounced upon the earth for man's sake; so that under the genial influence of the sun upon the gases of the atmosphere and upon the earth organic life was evolved out of the seeds or primary elements of the vegetable kingdom that were created in the earth in the beginning, when God created the heaven and the earth. And soon the earth stood forth beautifully clothed in a carpet of living green. "And the evening and the morning were the third day." The earth has now passed over three-sevenths of her orbit, and in her progress toward the sun has reached the confines of the solar system, and God issues his commands for the birth of time, the three preceding ages of creation being in eternity, before time was ordained. Then, upon this theory, we have the mineral kingdom, the dry land,

and the seas, created in eternity past; and not only the mineral kingdom, the dry land, and the seas, but the vegetable kingdom also; and the earth was clothed in living green in the ages of eternity anterior to the existence of time. These eternal ages are the periods of duration in which the eternal and infinite God keeps the record of all his works. But now time is to be ordained, these eternal ages are to be subdivided into measurements of time for the convenience of finite beings, to mark the periods and record the events of finite things.

It is not necessary in this treatise for me to give my interpretation of the historical record of creation during the remaining four ages of its historical account, because it is in the historical account of the first three ages, particularly that of the third age, that agricultural science, on the theory of the recuperating energies of nature, finds its chief support. This theory of the origin and formation of the earth may not agree in all respects with the teachings of geological science; and as I am not acquainted with the science of geology and its teachings, I am not prepared to harmonize their differences; but this theory seems to harmonize so well with the historical account of creation as recorded in the Bible that I am constrained to regard it as the true solution of the origin and formation of the earth. Whatever geological science may teach in regard to the origin of internal heat, there is no difference in regard to its existence; but whether geology teaches that internal heat is necessary to the present condition and perpetual fertility of the earth I do not know. But while this theory admits that there may have been and may continue to be many partial and local revolutions of the earth as a result of the expansive force of internal heat,



yet it teaches that there never has been but one radical and universal revolution resulting from the expansive force of internal heat, and that universal revolution caused by internal heat occurred when the "dry land was made to appear, and the waters were gathered together unto one place." Though that revolution might have been gradual and running through a long period of duration, attended by many violent eruptions in many parts of the earth, this would in no wise interfere with the progressive development of creation until all the orders of material being had been brought out of chaos, and made to stand before the eye of the Creator in the beauty of perfection as at the end of the sixth age. There could have been no universal decadence and renewal at the end of every successive age without destroying the harmony of that progressive development which commenced when God created the heaven and the earth in elementary properties in the beginning of the first age, to be developed and brought in progressive order during the succeeding ages, until all that was created in the beginning was brought to perfection, and chaos was exhausted and swallowed up in the perfection of order at the end of the sixth age. My conception of geology, without knowing the fact that it does so teach, is that up to this the third age of the world the earth had gone through three radical and universal revolutions of decadence and renewal, and that as the earth has now gone through six of its ages it has passed through six such decadences and renewals. This successive decadence and renewal of the works of God in creation would most certainly be to put an end to the eternal law of progressive development by limiting the natural forces of creation to the end of each successive age; and it necessarily follows

that if the natural forces can be limited, the natural attributes of God are not eternal. But we know that all the attributes of God are eternal. The natural attributes of God, operating through the laws of nature, may bring the natural world to a state of natural perfection; and then, under the progressive law of eternal development, the natural forces may cease to operate through natural laws, and then moral forces may be brought into exercise, and through the operation of moral laws the natural world may be changed into a spiritual world; and so successive changes may follow, through the development and manifestation of unknown and unrevealed attributes of God, throughout the ceaseless ages of eternity. By decadence and renewal of the works of God in creation, at the end of every succeeding age the progressive law of eternal development would be destroyed, and the glory of God, in the perfection of all his attributes, could never be made manifest.

Geology teaches that the history of creation may be correctly read in the stratified rocks, and the deposits that rest upon them in the bosom of the earth, through each succeeding age. That these stratified rocks and their deposits do exist, in regular and successive order, in the crusts of the earth, there can be no doubt, for they were so deposited by the laws of nature. If they had not been deposited in regular and successive order, they would have been in disorder and confusion, which could not have resulted from the regular operation of the laws of nature. So, then, the regularity of their order proves them to have resulted from the operation of nature's laws. But let me respectfully ask the question of the geologist, Is there no other mode, through the operation of nature's laws, by which the regularity of these deposits might be secured, than that of suc-

cessive decadence and renewal of the crusts of the earth in the order of progressive creation? Is nature so limited in her forces that she could find no other mode for the operation of her laws to effect this regular order of deposits in the crusts of the earth than that of decadence and renewal? If it can be successfully shown that nature can be thus limited in her forces and confined in the operation of her laws, then it may be taken for granted that decadence and renewal are the order of God in the economy of nature. But let us take the historical account of creation, as recorded in the Bible, and see if it does not unfold to us a law in nature by which both the character and the regularity of these deposits that form the crusts of the earth might be secured without successive decadence and renewal. That record says: "In the beginning God created the heaven and the earth." That is, in the beginning of the first age of the world God created the heaven and the earth. If this declaration be true, then God has created nothing since the beginning of the first age. The earth has not gone into decay, to be made again by a new and successive creation with every successive age, for then there would be no first age in the natural economy of God, but each and every age would be the beginning and the end of the dispensation of nature in the natural economy of God, and there could be no succession of ages in the history of creation. But God created in the first of the first age all things in elementary properties, and consequent chaos and disorder, to make and bring into order, during the five succeeding ages mentioned in the record, all that in the beginning of the first age he had created in elementary properties. In the mineral elements existed the chief if not all the properties which God created

in the beginning of the first age to make in the succeeding ages into form and structure, both of the vegetable and the animal kingdoms." If it is a law of nature in chemical science that all minerals in solution have an affinity for their own properties, so that in condensation they would come together, if there were no obstructions by reason of other minerals in solution with which they were mingled, and being thus prevented from coming together, they would by affinity assimilate with such minerals as were most like them in their properties, then, I think, we have the ground from which, by deduction, we can find a law of nature that would deposit, in regular and successive order, the different strata of rocks and earths, with all their peculiar properties and characteristics.

When the first great and universal revolution of the earth was caused by the expansive force of internal heat, a large portion of the mineral matter created in the beginning in elementary properties had, by cohesion, condensed into a solid mass at the center of the globe of waters, and by the heat that was concentrated there it was melted, or put into a liquid state, and, by affinity and assimilation, deposited in regular and successive strata in the crusts of the earth during the long period of duration through which the expansive force of internal heat was operating to elevate the dry land above the surrounding waters, each successive strata of rocks and earths coming together, by affinity and assimilation, in its own respective mineral properties and characteristics; and the earths all being composed of mineral matter in diversified combination, it would be an absolute necessity to the perpetual sustenance of the vegetable kingdom for the different strata composing the crusts of the earth to be so deposited that the veg-

etable kingdom might be supplied with the mineral elements in proper combination, as they were driven in gaseous form by the force of internal heat through the crusts of the earth, and lodged in the surface-soil of the earth, to be there again acted upon by the external agents, and put in condition to be assimilated and appropriated as plant-food for the development and support of the vegetable kingdom. The vegetable kingdom, coming, as it does, in organic structure, and deriving its peculiar properties from the combination of mineral element, formed in the surface-soil through the force of the external agents. The surface-soil being the point of contact between the internal forces and the external agents, the surface-soil then becomes the womb of nature, from whence springs the organic structure and life of the vegetable kingdom, and which comes, as it were, by generation from the union of the internal forces with the external agents in the surface-soil. If these assumptions be true, may we not reasonably suppose that the geological formations of the earth, as it now exists, with its different strata of rocks, minerals, and earthy deposits, with all their diversified forms and peculiar characteristics, were the result of the first great and universal revolution, caused by the expansive force of internal heat that first elevated the dry land above the surrounding waters. But during the lapse of that long period of duration which has occurred since the first elevation of the dry land above the waters, doubtless many local revolutions have occurred in the crusts of the earth, many local submergences and elevations, until, perhaps, there is not now any part of the earth's crusts existing as it did when, by the expansive force of internal heat, it was first elevated above the waters, and the dry land first appeared. Then there was no

organic life. But in succeeding ages organic life was developed, and the revolutions of succeeding ages have carried the fossil remains of organic life to the lowest depths, and raised them to the highest elevations of the crusts of the earth. If these assumptions be true and correct positions, then from this stand-point I can see no lack of harmony between geological science and the historical account of creation, as recorded by Moses, only in the assumption of the teachers of geological science that each of the strata of rocks and earthly deposits in the crusts of the earth marks a decadence and a renewal of the works of God in creation—an assumption that is nowhere recognized in the Mosaic record—and is an assumption that is no more necessary to geological science than is the assumption in agricultural science that the earth is possessed of a definite amount of the mineral elements of plant-food down to a certain depth, and that by continued cropping they will all be taken out of the soil in the crops, and the land will thus be made barren and the earth made a desolation, and that to perpetuate the fertility of the soil it is necessary for the mineral elements of plant-food, taken out of the soil in the crops, to be returned to the soil by artificial means. This assumption in agricultural science teaches that the God of nature has not provided in the laws of nature the remedial means of her exhaustion that would continually perpetuate the visible glory of his natural attributes; but that the God of nature having once made the glory of his natural attributes visible in the creation of the natural world, he leaves it either to the ability or to the capricious will of man to perpetuate his glory in creation by making it to depend upon man, by artificial means, to return to the soil the mineral elements of plant-food that would per-

petually bring forth the vegetable kingdom that sustains all animal life. This assumption in agricultural science makes the glory of the Creator, in the visible manifestation of the glory of his natural attributes, to depend upon the capricious will of the creature—a position too absurd to need an argument for its refutation.

If the solids of the earth are continually being dissolved by internal heat, and by its expansive force are continually being made to escape through the crusts of the earth in gaseous vapor into the air, I may be asked the question, What is to prevent the whole crusts of the earth from ultimately becoming gaseous, and all the solid globe, with all its teeming millions of organic life, both vegetable and animal, from ultimately becoming vaporized, and passing off in thin air? I can only answer this question by referring to the conceded fact that mutation of matter is a universal law of nature, and that the solids of the earth are continually being dissolved by internal heat, and forced off through the crusts of the earth into thin air, and carrying with it, in vaporized condition, much of the surface waters of the earth, where it is again condensed by cold, a regulating force of the external agents, and returned again to the earth in water in the form of snow, rain, and dew; and being again returned to the surface of the earth as water impregnated with its original mineral elements, it is again ready to be crystallized, and be again dissolved by internal heat, and forced out by expansion through the crusts of the earth into its former aerial state. And thus by the mutation of matter the crusts of the earth are being continually vaporized, and, passing off in gaseous forms, and being returned to the surface of the earth

in water, are again crystallized, and again form the solid crusts of the earth.

And so the material elements will continue, by mutation of matter, to change the forms and relation of material being through all the ages of this world's duration, when at the end of that duration, the God of nature shall proclaim that his purposes of creation have been accomplished, and all matter shall be changed into spirit, and a spiritual world of visible identity shall be made to take the place of the visible material world. So we find that the law of mutation is not confined in its operations to time, nor limited in its operations to the material world; but that it is an attribute of God that runs through all the ages of eternity, changing the glory of God and the happiness of intelligent creation from dispensation to dispensation in the natural and moral economy of God, running through all the ages of eternity, embracing the universe within its compass, and forever, in the order of successive ages, making manifest the glory of God in the perfection of all his attributes, both natural and moral, according to his eternal purpose, from the foundation of the world.

Thus it is, by the mutation of matter as a law of nature, acting through the force of internal heat, driving through the crusts of the earth in gaseous form into thin air the mineral elements of plant-food that tend to destroy the fertility of the soil. But the same law of mutation meets, as the recuperating energies of nature, the escaping gases in the surface soil, and new combinations are formed, changing the escaping gases of mineral matter into a less volatile state, and so holding them until so much of them as is necessary to the productiveness of a fertile soil is appropriated as



life-sustaining food to the vegetable kingdom, through their roots that are embodied in the surface soil. The mineral elements that were forced out through the crusts of the earth by internal heat from its center could never of themselves impart organic structure and life to the vegetable kingdom; but they were met in the surface soil by the external agents that impart natural life, and were by them held in the surface soil until new combinations of mineral properties took place, and new forms of being followed as a result of the new combinations. And by cohesion of the internal forces, and the external agents in the surface soil, vitality was imparted to the soil, the earth was fructified, and by generation made to bring forth organic structure and life. And soon the multitudinous orders of the vegetable kingdom were brought out of chaos, and the earth was clothed in the habiliments of living verdure. In obedience to the commands of the God of nature, the internal forces and the external agents, as if in affianced love, continued to meet in the surface soil, and the earth continued spontaneously to bloom in youthful vigor, and bring forth her fruits spontaneously for the sustenance of the higher orders of creation. But at the end of the sixth age of the world's existence, this harmony between the internal forces and the external agents was impaired, and the earth was cursed for man's sake. And it became necessary for man to cultivate the soil, that he might, by cultivation, restore to the soil that productive fertility which it had lost by this loss of harmony between the internal forces and the external agents. These considerations of natural cause lead necessarily to the conclusion that on account of the violation of the moral laws of God by man the external agents of nature

were thrown into confusion and disorder, depriving them of the power to act with that regularity and uniformity that had previously characterized them; causing chemical combination to take place in the atmosphere, producing that vicissitude of aerial phenomena which causes violent storms of wind, rain, hail, and snow, on various localities of the earth's surface, scattering too much water, at times, in some localities, and not enough in others; washing away with floods of water the surface soil in some localities, and depositing it in others, causing drought, and making the earth, at times, in some localities to lose her productive fertility for the lack of water and a proper degree of moisture; and at other times, in some localities causing the earth to lose her productive fertility by too much water and excess of moisture. All these destructive tendencies of nature the farmer must encounter and counteract to the best of his ability, as a part of his duty as a cultivator of the soil, because for man's sake, on account of his violation of the moral laws of God, they are the result of the disorder and confusion in the external agents of nature that were brought upon the earth as a curse upon the earth for man's transgression.

These evils, as resulting from the disordered condition of the external agents of nature, were too small in comparison with other evils, resulting from the same cause, to be mentioned in the recorded history of nature, only by incidentally referring to the fact that up to this time—that is, up to the regeneration and spiritual creation of man—it had not rained upon the earth, thus clearly indicating the harmony that had previously existed between the internal forces and the external agents of nature. Up to this time the uniformity and regularity of falling dews, caused by the condensation

of ascending vapors, had furnished the earth with sufficient moisture to arrest in the surface soil the mineral elements that were escaping in gaseous form through the crusts of the earth, and hold them there until by the force of other external agents they were changed, and by combination, other properties were developed that would make them suitable plant-food to bring forth and sustain the vegetable kingdom with perpetual uniformity and regularity so long as harmony prevailed between the internal forces and the external agents. The greater curse that was denounced upon the earth in consequence of man's transgression was that of partial barrenness. The earth was made to lose to a great extent the elements of productive fertility, and failed to bring forth the organic elements of vegetable life in sufficient abundance to sustain the organic life of the animal kingdom. But instead thereof, it was made to bring forth "thorns also, and thistles," things pertaining to the vegetable kingdom, in consequence of man's transgression, upon which no animal can live. The external agents of nature being charged with the power to impart natural life to the vegetable kingdom—the seed of which was planted in the earth at its creation to be brought forth through the surface soil in organic form and structure by the internal forces coming in contact with the vital forces of the external agents in the surface soil—the mineral elements that were continually escaping through the surface soil, being driven out by the internal forces, were by contact with the external agents in the surface soil changed by chemical combination into other and diverse properties, and being vitalized by the contact, each separate combination possessing its own vitality, built up for itself its own peculiar organic structure, from

whence is derived the great diversity of organic structure and properties of the vegetable kingdom. The external agents being thrown into disorder and confusion by man's violation of the moral laws of God, it became necessary in the moral economy of God that man should repair the damages, for he could not restore the order, but that he should repair the damages and heal the wounds which his own moral conduct had inflicted upon nature. Hence the curse upon the earth for man's sake, that he should cultivate the earth, saying, "In the sweat of thy face shalt thou eat bread, till thou return unto the ground; for out of it wast thou taken: for dust thou art, and unto dust shalt thou return." That man might by cultivation put the surface soil in such mechanical condition that the external agents might meet and hold in it the escaping mineral elements of plant-food that were continually being driven up in gaseous form through the crusts of the earth, and by cultivation restore again at least partial harmony between the internal forces and the external agent that had been impaired by man's violation of the moral laws of God—to make man labor and toil in cultivation, that he might by cultivation perpetually keep the surface soil in mechanical condition, to be the continued lodgment of the vital forces, imparted by the external agents—the earth was made to bring forth thorns and thistles, wild and noxious vegetation, that must be subdued by cultivation before the vital forces, through the external agents, could cause the earth to bring forth bread to man. Thus it is that the exhaustion of the earth's fertility is produced by mutation of matter that is continually being carried on between the internal forces and the external agents through the operation of nature's laws for evil to man, on ac-

count of his transgression of the moral laws of God. While it is by the mutation of matter continually carried on between the internal forces and the external agents through the operation of nature's laws that the soil is perpetually kept fertilized with the life-sustaining elements of plant-food for man, yet it requires perpetual obedience to the God of nature in the cultivation of the soil which he has ordained as the means for keeping the soil in mechanical condition, to be vitalized by the external agents. It is through this perpetual obedience of perpetual and good cultivation that the recuperating energies of nature, through the operation of nature's laws, perpetually maintains the fertility of the soil. While I hold this to be the true theory of agricultural science, I would only repudiate that part of agricultural science, as now taught, that holds to the idea that there is a fixed and definite amount of the mineral elements of plant-food in the surface soil down to a certain depth, and that by continued cropping these may all be taken out of the soil in the crops grown upon the land, and that the soil may be thus deprived of its elements of fertility, and that complete exhaustion will follow continued cultivation, unless these elements of fertility are returned to the soil by artificial means. I would in no wise repudiate that part of agricultural science that teaches the importance of using fertilizers upon the soil, because a proper and judicious use of fertilizers upon the soil is a part of that obedience due in perpetual cultivation. But the use of artificial fertilizers is not required because they are the only fountain of supply from whence the mineral elements of plant-food can be furnished to an exhausted soil, but because the fertilizers, when applied to the exhausted soil, put the

soil in such a mechanical condition that the external agents can gather and retain in the surface soil the mineral elements of fertility that are continually escaping in gaseous form through the crusts of the earth; and being retained in the surface soil, their properties are changed by chemical combination, and vitality is imparted through the external agents, and they become organic food to supply the wants of organic crops that are growing in the soil. If there were no other fountain of supply for the elements of productive fertility to the soil than that which the art of man can make, or the labor of man can supply, by the application of artificial fertilizers, or fertilizers made from the crops, returning to the soil that which he had taken off in his crops, less the unavoidable waste, the earth would soon become a barren waste, and the world a desolation without an inhabitant. So small an amount of the elements of productive fertility can be returned to the soil by artificial means, or by the labor of man in comparison to its requirements, that it would be less in comparison than a drop to the great ocean of waters. But when we consider the mechanical effects of fertilizers applied to the soil, putting the surface soil in mechanical condition for the external agents to meet and hold in the surface soil the mineral elements of fertility that are continually escaping through the crusts of the earth, and there converting them by chemical combination into organic plant-food, the importance of using fertilizers, though comparatively small in amount, can hardly be estimated. As valuable and as important as artificial fertilizers may be—all the fertilizers that the skill and the art of man can make, or the labor of man can apply to the soil—yet but comparatively a very small portion of the tilla-

ble land of the earth's surface can receive their benefits. And all that portion that cannot receive the benefits of artificial fertilizers must be kept up by some other means than that of applied fertilizers.

To determine these means, and their best adaptation to secure the ends proposed, is the test of practical cultivation. These means are so numerous, and the contingent circumstances connected with their use are so varied, that they cannot all be subjected to any universal rules in practical cultivation. All cultivators of the soil know that thorough and fine pulverization of the surface soil is necessary to its highest productive fertility in most of the crops grown upon the land; but they differ in opinion as to the depth to which the soil should be pulverized, both in its preparation for the seed and in the cultivation of the crops. This diversity of opinion does not result from the necessity of thorough pulverization of the soil, for thorough pulverization only puts the soil in mechanical condition for the free and full action of the vital forces imparted by the external agents, and gives the external agents increased power to hold and put in proper combination the escaping elements of productive fertility. This difference of opinion depends upon the condition of the various soils to be cultivated, some soils not admitting of deep cultivation to develop their greatest productive fertility, while the productive fertility of other soils will be greatly increased by deep stirring. Then, to determine the proper depth of cultivation depends upon the experience, the observation, and the judgment of the cultivator. An important consideration connected with deep or shallow stirring is that of gradually deepening the surface soil in land that will only admit of shallow cultivation, in order, by deepening

the soil, to furnish more room and greater facilities for the action of the external agents. But here again the judgment of the cultivator is called into requisition, for this must be done with caution, not turning too much of the clay subsoil at one time; lest by so doing the permeating power of the external agents be cut off, their power of arresting and combining the escaping elements of fertility be lessened, and their power of imparting vitality to the soil be impaired. Another mode of perpetuating the productive fertility of the soil is that of turning under a crop of vegetation that has grown upon the soil, either dead or in its green state. But if it is put under in its green state, it will decompose quicker, and yield in a shorter time a greater amount of fertilizing properties; not that there is any great amount of fertilizing elements in any crop that may be turned under, but the crop turned under does, by fermentation and decomposition, put the surface soil in mechanical condition to be permeated by the external agents, giving it greater power to gather, hold, and combine into organic plant-food the escaping mineral elements that internal heat is continually forcing out through the crusts of the earth.

Rotation of crops is another mode, pointed out by nature, of increasing the fertility of the soil, or of increasing the productive yield of crops; for we see that every few years the annual crops of spontaneous vegetation are changed from one class to another. How this increase of productive fertility is brought about by a rotation of crops is not easily perceived, unless it be supposed that by the cultivation of the soil in one crop for a series of years in succession it gathers a superabundance of the fertilizing properties necessary to sustain other crops, drawing away from the soil and



appropriating to their use, or rendering inert in the soil the fertilizing properties necessary to sustain the crop that has been long in cultivation. The increased yield, by a change to other crops, would seem to indicate that this is a correct solution of the advantages gained by rotation of crops; for we perceive that although the soil refuses to bring a bountiful yield of one crop after long-continued and successive cultivation of one crop upon the same land, the soil is not exhausted, for by changing to some other crop a bountiful yield is obtained. Be this as it may, the facts of nature are stubborn things, and cannot be ignored with impunity.

Mulching the ground with any dead vegetation, during the dry and hot seasons of the summer and fall, is a mode of increasing the fertility of the soil, by retaining the moisture in the surface soil, thus putting it in mechanical condition to store up and hold in readiness the fertilizing elements that are continually escaping through the crusts of the earth to be combined into life-sustaining food for the succeeding crop.

Fallowing the land has been resorted to as a means of increasing the productive fertility of the soil, and was in use in agricultural practice among the Hebrews, in the flourishing days of Jewish prosperity and greatness. But, judging of what would be necessary to make this mode of increasing the fertility of the soil upon theoretical grounds, in the absence of any experimental or practical observation of its effects, I should conclude that, under this mode of increasing the fertility of the soil, to make it efficient it would require the expenditure of more labor upon the land in fallowing than would be necessary to make a crop upon the same land, for it would have to be turned as deep as

the character of the soil would admit, as early in the season as possible; and then continued and repeated shallow cultivation of the surface must be kept up through the whole season, so as to keep the surface pulverized and brought to a state of fineness that would act as a mulch to the underlying soil, thus causing it to retain moisture, and enabling it to gather and hold the escaping elements of fertility that are continually passing off in gaseous form through the crusts of the earth. But, notwithstanding the amount of labor necessary to success, I am of the opinion that with proper attention to drainage, to keep the loose and naked soil from washing off, fallowing can be made the most efficient and best paying mode of natural fertilization. If, when the land is turned in in the spring, a good green crop of some of the winter cereals—oats, rye, or barley—be turned under, and the surface be kept sufficiently fined by shallow cultivation during the whole season, the fermentation and decomposition of the green crop would add greatly to the mechanical condition of the underlying soil, and thereby enable it to gather and hold in greater abundance the elements of escaping fertility, while at the same time it would clear the ground of weeds and noxious vegetation, and render the soil so mellow and easy of cultivation the next year that this alone would almost pay for the extra labor of the fallow year. This, however, is only an opinion based upon theoretical conclusions, without any practical observations; yet the theory holds out such promising hope of material aid that I doubt not it will be brought to the test of practical observation, and the old Jewish mode of fertilization by fallowing, that was suggested and sanctioned by divine authority, will be again brought back into use in greater per-

fection than in the most flourishing days of Jewish agricultural prosperity.

Clover and peas are a class of vegetation that, even while growing, are not regarded as exhausters of the soil, but, on the contrary, are considered as natural fertilizers. But upon what theory in the economy of nature they cease to be exhausters, and become fertilizers of the soil, is undetermined, either by agricultural science or by the observation of practical agriculturists. But, upon the theory set forth in this treatise, I think it is probable that the fertilizing power of this class of the vegetable kingdom is due in great part to the fact that they possess an affinity for certain mineral elements of plant-food drawn from the soil, which causes them to send forth a luxuriant growth of stems and leaves impregnated with these elements of plant-food, thus furnishing a shade to the ground that becomes a natural mulch, producing moisture that retains and holds in the soil the elements of escaping fertility, while the plants themselves are not exhausters of the elements of fertility gathered in the surface soil through the mulching power furnished by their shade, carrying off from the soil no fertilizing elements, either in growth or by evaporation; while other classes of vegetation furnishing shade to the ground are themselves exhausters of the soil.

If this theory of natural fertilization be correct, then let the inhabitants of the earth rejoice in deliverance and freedom from the lash of the dread of ultimate starvation, which is being held in threatening attitude over their heads by that system of agricultural science which teaches man that he must return to the soil all the fertilizing elements that he takes from it in his crops, because there is only a fixed and definite amount

of the fertilizing elements in the soil, and if he fails to return to the soil all that he takes off in his crops, ultimate starvation must follow.

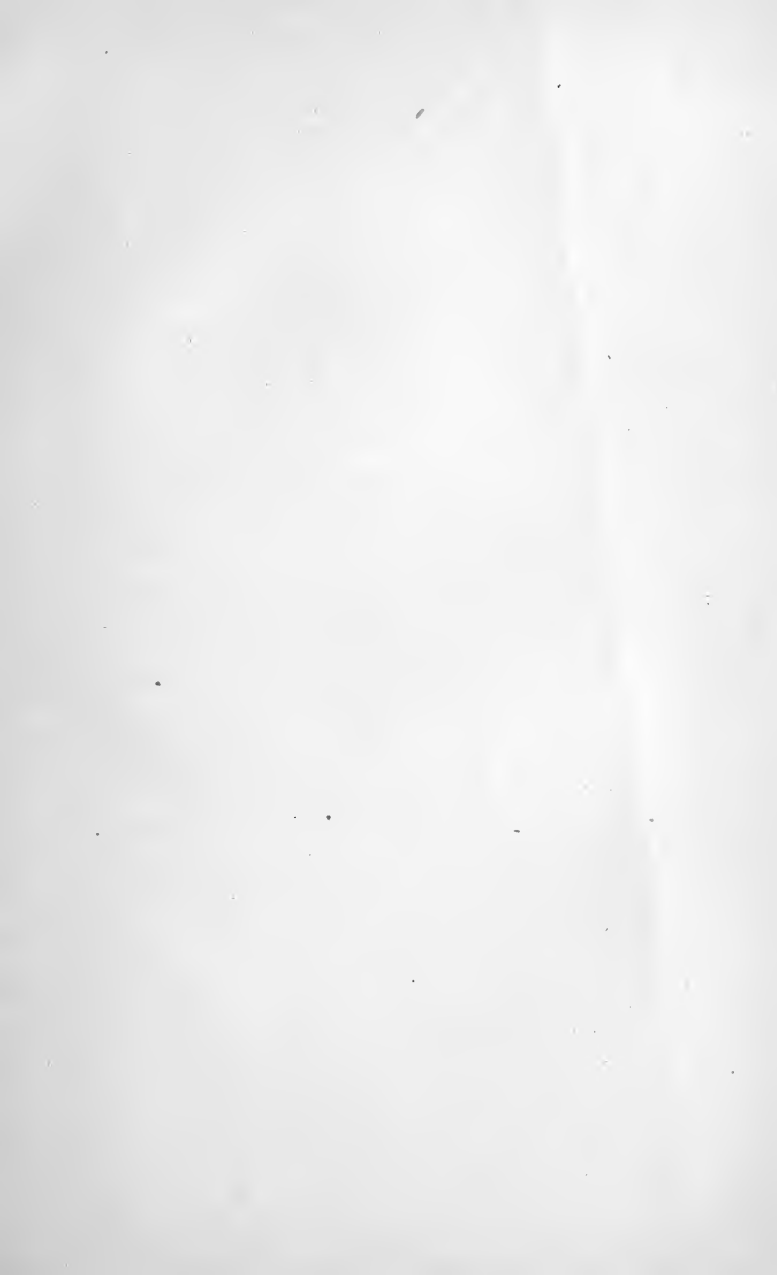
It cannot be believed that the God of nature ever ordained such a system of natural economy as that, which makes the perpetual productiveness of the earth to depend upon the labor of man, without providing in nature the means whereby his labor might secure its perpetual productiveness.

But again, if this theory of natural recuperation be correct, let the cultivators of the soil rejoice in hope of their emancipation from the chemist and the manufacturer of artificial fertilizers, who seem to be combined to lay the heavy burden of untold millions of dollars upon the shoulders of the cultivators of the soil, to be necessarily expended, as they claim, in the purchase of artificial fertilizers.

Believing that this theory can in nowise result in evil, but hoping that it may be productive of beneficial results, the author respectfully submits this treatise to the consideration of scientific investigators, and to the test of agricultural experiment and observation.













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